INDOOR AIR QUALITY ASSESSMENT

Saugus Town Hall
Main Street
Saugus, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
Emergency Response/Indoor Air Quality Program
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Background/Introduction

At the request of Deborah Rosati, Director of Public Health for the Saugus Board of Health, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the Saugus Town Hall (STH), Saugus, MA. General complaints of poor air quality and temperature control prompted the inspection.

On February 12, 2003, a visit to conduct an indoor air quality assessment was made to the STH by Cory Holmes, an Environmental Analyst in BEHA's Emergency Response/Indoor Air Quality (ER/IAQ) program. Mr. Holmes was accompanied by Kevin Nigro, Director of Inspectional Services and Ms. Rosati, for portions of the assessment.

The STH is a two-story, wood clapboard-sided building constructed in 1875. The building was renovated in 1999. The building has a peaked, shingled roof with a steeple in the center. Windows are openable throughout the building. The building contains town offices and public meeting rooms.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor, Model 8551.

Results

The STH has an employee population of approximately 30-35 and is visited by approximately 100-150 individuals daily. The tests were taken during normal operations. Test results appear in Table 1.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 ppm (parts per million) in three of nineteen areas surveyed, indicating adequate ventilation in most areas of the building. Fresh, heated air is supplied by air-handling units (AHUs) located in a mechanical room on the ground floor. Fresh air is drawn into the AHU through fresh air intakes on the exterior of the building (see Picture 1) and delivered to occupied areas via ceiling-mounted air diffusers (see Picture 2). The ventilation system is not equipped with an exhaust component to return air back to the AHUs. Without a mechanical exhaust system, normally occurring environmental pollutants can build up and lead to temperature/comfort complaints.

The ventilation system is controlled by thermostats. Thermostats have a fan control, which can be set to either "auto" or "on". At the time of the assessment, several switches were set to "auto", which deactivates the AHUs once the temperature set on the thermostat is measured. BEHA staff recommended that the fan switch be placed to the "on" position to provide continuous airflow to the space. Without mechanical ventilation running continuously, fresh air cannot be introduced on a consistent basis.

Ductwork and a vent/grill were installed in the safe area (see Pictures 3 & 4). No airflow was detected from the vent during the assessment; therefore, the function of the vent (supply/exhaust) could not be determined.

The Massachusetts Building Code requires a minimum ventilation rate of 20 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied.

Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please refer to Appendix I.

Temperature readings ranged from 69^{o} F to 74^{o} F in occupied areas, which were very close to the BEHA recommended comfort guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. Temperature and poor airflow complaints were expressed in a few areas, particularly in the accounting office. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply.

The relative humidity measured in the building ranged from 14 to 26 percent, which was below the BEHA recommended comfort range. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

The STH is equipped with a gutter/downspout system to direct rainwater away from the building. In some cases the gutter/downspout system empties water directly against the foundation (see Pictures 5). These conditions can undermine the integrity of the building envelope and provide a means of water entry into the building through capillary action through foundation concrete and masonry (Lstiburek & Brennan, 2001).

A number of areas had water coolers installed over carpeting. Water spillage or overflow of cooler catch basins can result in the wetting of the carpet. In addition some of the coolers had residue/build-up in the reservoir. These reservoirs are designed to catch excess water during operation and should be emptied/cleaned regularly to prevent microbial and/or bacterial growth.

Other Concerns

Occupants in the accounting office reported odors stemming from a floor drain/trap that occur intermittently and at random times. The drain appeared to be properly sealed and no odors were detected or reported by occupants the day of the assessment.

Exacerbation of allergies and skin, respiratory and eye irritation (s) were reported by employees in the Town Clerks office and by employees that visit the vault. The vault, located at ground level and the clerks office on the first floor both house historic documents of very old age. Many of the items (e.g. ledgers) have been water damaged over the years, are dusty and/or have bindings in disrepair (see Pictures 6 & 7). The book in Picture 8 was taken from a shelf in the vault at random and contained a bird feather and dander. Occupants could not recall a roosting problem with birds. Accumulated dirt, dust, potential mold from water damaged/damp books and animal dander can all serve as sources of irritation. No mechanical or natural ventilation could be identified within the vault. Without mechanical ventilation these irritants are neither diluted nor removed from the environment. In recent conversation with Ms. Rosati, the town has contracted Service Master, Inc., a professional remediation firm to conduct cleaning and disinfection in the vault (Rosati, 2003).

Finally, a number of areas contained photocopiers. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992). Photocopiers should be located near local exhaust ventilation or in well-ventilated areas (e.g. hallways).

Conclusions/Recommendations

In view of the findings at the time of this assessment, the following recommendations are made:

1. Continue working with current HVAC contractor to address temperature/comfort problems. A coordinated effort should be made between the contractor and occupant representatives, building liaisons and maintenance personnel to resolve these issues.

2. Examine the feasibility of installing mechanical exhaust ventilation.
3. Maximize air exchange by operating the ventilation system continuously during periods of occupancy independent of thermostat control.
4. Encourage STH staff to report any complaints concerning temperature control/preventive maintenance issues to the facilities department.
5. Relocate photocopiers and other heat generating office equipment from the vicinity of occupants, if possible.
6. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a HEPA filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).
7. Redirect or extend downspouts to direct water away from the base of exterior walls.
8. Contact a licensed plumbing contractor to investigate complaints/leakage of odor from the drains in the accounting office.
9. Determine the function of the vent in the vault. If mechanical, reactivate; if not, examine the feasibility of installing local exhaust ventilation.
10. Determine future preservation, handling and/or storage actions for materials currently stored in the vault area and in the Town Clerk's office. The inherent conditions of aged/vintage materials (e.g. ledgers/records) have created an environment conducive to eye, skin and respiratory irritation. These boxes, documents, books and other stored

materials will continue to be a source of mold and/or particulates. In this case, ventilation alone cannot serve to reduce or eliminate these materials. As an initial step, options concerning the preservation of materials stored in this area should be considered. Since many historical records appear to be stored in these areas, an evaluation concerning disposition of these materials must be made. Porous materials that are judged unworthy of preservation, restoration or transfer to another media (e.g. microfiche or computer scanning) should be discarded. Where stored materials are to be preserved, restored or otherwise handled, an evaluation should be done by a professional book/records conservator. This process can be rather expensive, and may be considered for conservation of irreplaceable documents that are colonized with mold. Due to cost of book conservation, disposal or replacement of moldy materials may be the most economically feasible option.

References

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OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

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SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0

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Picture 1

Fresh Air Intakes for HVAC System

Picture 2

Ceiling-Mounted Fresh Air Diffuser

Picture 3

Grill installed in Vault Area

Picture 4

Ductwork Attached to Grill in Vault Area

Picture 5

Downspout/Gutter System Emptying Water Against Foundation

Picture 6

Disintegrating Binders of Old Records

Picture 7

Old Town Records Discolored/Water Damaged

Picture 8

Book Chosen at Random from Shelf in the Vault, Note Bird Feather and Dander

TABLE 1.1

Indoor Air Test Results –Saugus Town Hall, Saugus Massachusetts February 12, 2003

Location	Carbon Dioxide (*ppm)	Temp (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Background	440	34	42					Cold – snow flurries
Auditorium	517	70	19	10	Y	Y	Y	High efficiency pleated filters in HVAC system
Inspectional Services	679	73	22	4	Y	Y	N	Plants
Night Office	798	73	23	5	Y	Y	N	
Inspectional Services Annex	786	74	22	4	N	Y	N	
Purchasing/Personnel	874	74	22	3	Y	Y	N	
Lunchroom	551	73	21	0	Y	Y	Y	
Copy Machine Room	633	73	21	0	Y	Y	Y	Photocopier off machine
Accounting	1180	72	26	4	Y	Y	N	Poor air flow/heat complaints, photocopiers and office machinery
Accounting Inner Office	1202	72	20	2	N	Y	N	Occasional odors-floor drain/trap
Computer Room	691	72	20	0	N	Y	Y	Computer equipment (heat)

*** ppm = parts per million parts of air**

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 1.2

Indoor Air Test Results –Saugus Town Hall, Saugus Massachusetts — February 12, 2003

Location	Carbon Dioxide (*ppm)	Temp (°F)	Relative Humidity (%)	Occupants in Room	Windows Openable	Ventilation		Remarks
						Supply	Exhaust	
Ground Floor Men's Room	512	70	21	0	N	Y	Y	Passive intake
Ground Floor Ladies Room	592	70	21	0	N	Y	Y	Passive intake
Selectman Office	595	69	19	1	Y	Y	N	
Town Manager	622	72	19	1	Y	Y	N	
Town Clerk	538	74	14	2	Y	Y	N	Photocopier
Town Clerk	581	73	15	0	Y	Y	N	Old books Town records
Assessors	548	72	14	3	Y	Y	N	
Conference Room	474	72	14	0	Y	Y	N	
Treasurer Office	573	73	16	4	Y	Y	N	Photocopier, plants Office equipment
Vault					N	---	---	Old documents/books/logs, dirt/dust, bird feathers etc. Wall vent, no air flow

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